World Heritage Biodiversity:
Filling Critical Gaps and Promoting Multi-Site Approaches to New Nominations of Tropical Coastal, Marine and Small Island Ecosystems

Potential Tropical Coastal, Marine and Small Island World Heritage Sites in the Eastern Africa Region

Introduction

The objective of this paper is to review scientific and technical information to provide a basis for discussions to develop consensus on potential tropical coastal, marine and small island ecosystems for nomination as World Heritage sites in the East African Region. For a site to be included on the World Heritage List as natural heritage, the World Heritage Committee must find that it meets one or more of the following criteria:

> (i) be outstanding examples representing major stages of the earth's history, including the record of life, significant ongoing geological processes in the development of landforms, or significant geomorphic or physiographic features; or
> (ii) be outstanding examples representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals; or
> (iii) contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance; or
> (iv) contain the most important and significant natural habitats for *in situ* conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

The protection, management and integrity of the site are also important considerations. Mixed sites have both outstanding natural and cultural values. Since 1992 significant interactions between people and the natural environment have been recognised as cultural landscapes. The identification process can include the development of innovative multi-site nomination strategies for cluster and trans-border sites.

The East Africa Region includes the mainland countries of Somalia, Kenya, Tanzania, Mozambique and the island states of Madagascar, Mauritius, Reunion, Comoros, Mayotte (part of the Comoros island group but governed by France) and the Seychelles (Fig. 1). The region has only one marine world heritage site, Aldabra in the Seychelles, although Greater St. Lucia Wetland Park is situated on the border with the Southern Africa Region. Aldabra (accepted under criteria ii, iii & iv, above) is comprised of four large coral islands that enclose a shallow lagoon and are surrounded by a coral reef. It has become a refuge for some 152,000 giant tortoises *Geochelone gigantea*, the world's largest population of this reptile as well as a breeding site for Green (*Chelonia mydas*) and Hawksbill (*Eretmochelys imbricata)* turtles. There are large seabird colonies including thousands of nesting terns on the atoll. St. Lucia (accepted under criteria ii, iii & iv, above) is also a Ramsar site and contains a variety of landforms including coral reefs, long sandy beaches, coastal dunes, lake systems, swamps, and extensive reed and papyrus wetlands. The environmental heterogeneity, extreme conditions and a transitional geographic location has produced exceptional species diversity and on-going speciation. The site is also the largest estuarine system in Africa, the southernmost extension of coral reefs on the continent and a breeding area for large numbers of turtles. Whales, dolphins and whale-sharks migrate off-shore and there are huge numbers of waterfowl including large breeding colonies of pelicans, storks, herons and terns.

Background.

The climate of the East Africa Region is mostly tropical with sea temperatures between 20°-30°C and surface air temperatures rarely falling below 21°C (IUCN/UNEP, 1985). The continental shelves in the region tend to be narrow averaging 15-25 km in width with the narrowest point on the mainland being 100m (Pemba, Mozambique) and the widest, 145 km at Sofala, Mozambique. Beyond the continental shelf the seabed falls sharply to depths of about 4000m across the Indian Ocean except for the banks and islets associated with the island states (IUCN/UNEP, 1985). The Seychelles ridge, with 115 islands, is mostly granitic but also has coralline islands and limestone banks to the south and west of the group. The Comoros are an isolated group of four volcanic seamounts and smaller islands at the north of the Mozambique Channel. The higher points of the Mascarene Plateau, a discontinuous mid ocean ridge, form the islands of Reunion, Mauritius, Rodriguez as well as numerous shoals, seamounts and large submerged banks.

Oceanic currents and how they are affected by the monsoon seasons have a major influence on the biogeography of the region. The permanently west flowing south equatorial current is partially diverted south along the eastern coast of Madagascar (Madagascar Current) with the main current splitting into the northerly East African Coastal Current (EACC) and the southerly Mozambique Current close to the Mozambique-Tanzania border at Cabo del Gado (Fig. 1). The latter joins the Madagascar Current south of Madagascar to form the southerly Agulhas Current (IUCN/UNEP, 1985). However, according to Lutjeharms *et al.* (2000) the Eastern Madagascar Current may be fully retroflected in the Southeast and South and never actually round the southern cape of Madagascar. The Mozambique and Madagascar Currents generate a series of southwards drifting eddies in the Mozambique Channel that may be significant in larval dispersal patterns between Mozambique and the west coast of Madagascar (GBRMPA/WB/IUCN, 1995). From April-October the southeast monsoon accelerates the EACC (mean velocity 4-5 knots) along the coasts of Tanzania, Kenya and Somalia. The northeast monsoon generates the south flowing Somali Current and reduces the speed of the EACC. The Somali Current and EACC interact in southern Somalia (approximately at Latitude 2°N) to generate the eastward flowing South Equatorial Counter Current.

The East Africa Region (Western Indian Ocean) is considered a distinct subdivision of the world's largest biogeographic province, the tropical Indo-Pacific. This is based on biogeographic patterns of species such as corals where analyses have shown a clear separation of the Indian Ocean to the west of the Sri-Lanka-Chagos line (Sheppard, 1987; 2000). A major constraint in determining areas representative of the East African Region is the many and often contradictory subregional biogeographical classifications (seven in total). For the purpose of this report the biogeographical classification of GBRMPA/WB/IUCN (1995) is used. This classification defined five broad biogeographic zones based on ecosystems and habitats: (I) the Red Sea/Indian Ocean interface (north coast of Somalia), (II) Northern Area (Indian Ocean Coast of Somalia possibly Northern Kenya) (WWF, 2000), (III) Central Area (Kenya, Tanzania, Northern Mozambique and Madagascar), (IV) Southern Area (Southern Mozambique), and (V) Oceanic Islands (Seychelles, Mauritius and Comoros).

Marine and coastal habitats were classified into 38 types by IUCN/UNEP (1984a) and later reduced to 10 by GBRMPA/WB/IUCN (1995). The main coastal habitats in terms of diversity, ecological and biological importance are coral reefs and communities, mangrove forests and seagrass beds. Their distribution is largely determined by physical conditions e.g. substrate type, water temperature, exposure to wave action and the influence of freshwater. Richmond (1997; 1999) working with conservative diversity figures for major marine

macrofaunal shallow water taxa estimated a minimum of 10,627 species of which 10%-20% (depending on taxa) are endemic to the region. Species diversity within the East African Region tends to fall from east to west and with increasing latitude both north and south of the equatorial zone (Sheppard, 2000). The last few decades have seen major changes in the extent and status of marine habitats and disastrous declines in certain species e.g. the dugong. The 1990s also witnessed the massive impact of the 1998 coral bleaching event that caused up to between 70%-99% coral mortality on some reefs (Linden and Sporrong, 1999; Wilkinson *et al*. 1999).

These changes were brought about because of a number of widespread threats that are in many ways typical of those faced in the rest of the Indo-Pacific. The main threats for the Region are: over-exploitation of living resources, destructive fishing methods and associated habitat degradation, land and marine based pollution (chemical and eutrophication), siltation, habitat conversion for agriculture, tourism and to a lesser extent mariculture and climate change. Of these threats, climate change is clearly outside the scope of local or even regional management and will depend for resolution on the collective advocacy of all affected states. The designation of World Heritage Sites should serve to reinforce the argument that the major carbon emitting nations have a global responsibility for the protection of ecosystems far beyond their own borders.

Possible World Heritage Sites

The existing World heritage sites in and adjacent to the region provide some guidance for the identification of potential future candidate sites. Aldabra has a globally important population of a threatened endemic species (the giant tortoise) and significant breeding populations of other threatened species (turtles) as well as regionally important habitats (coral reefs) and species (birds). Greater St. Lucia has the largest estuarine system in African and high ecosystem, habitat and species diversity with extreme environmental conditions which combine, with its transitional geographic position, to produce ongoing speciation. Both sites also contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance. This combined with their biological and ecological importance led to their designation under criteria ii, iii and iv. This review will use a number of indicator ecosystem/habitat and species groups to identify sites that could meet the World Heritage criteria and the standards set by the existing sites.

There have been two recent initiatives that have prioritised important areas for conservation within the East African Region, the Global Representative System of Marine Protected Areas (GBRMPA/WB/IUCN, 1995) and East African Marine Ecoregion Programme (EAME) (WWF, in litt.). The latter however, only covered the African mainland states. Each of these initiatives used a number of ecosystem/habitat and species groups, many of which were common to all countries. For the purposes of this report the groups used will be a mixture of those used in those previous initiatives namely: coral reefs and communities; mangrove forests; seagrass beds; wetlands; beaches, dunes and cliffs; small islands and submerged banks; fish; turtles and other reptiles; birds, invertebrates and marine mammals. By identifying and overlaying globally and regionally significant areas for each of these ecosystem/habitat and species groups it will be possible to identify sites that are globally or regionally important for a number of these groups and so could meet one or more of the World Heritage criteria.

Coral reefs and communities occur along major sections of the mainland continental shelf between 5^{o}N and 25^{o}S as well as around the islands and possibly on the submerged banks but these are poorly known. Northern Kenyan reefs (e.g. at Kiunga) are predominantly rocky or

algal reefs with coral communities. During the northeast monsoon these reefs receive larvae from the north carried by the Somali Current and from the south in the southeast monsoon by the EACC (Samoilys, 1988 a,b) and as such could have a unique species composition with a mix of Arabian and East African species. South of this area to the Quirimba Islands, reefs are better developed with higher diversity of coral genera with Malindi in Kenya, Pemba and Mafia-Songo Songo Islands and Mnazi Bay in Tanzania as well as the Quirimbas Islands in Mozambique having a mixture of reef types with high diversity of coral genera (>50 genera). South of the Quirimbas to the South African border, 25 river outflows and cooler water temperatures restrict coral growth. The reefs to the south are commonly classified as coral communities and continue into South Africa (the most southerly extent of coral community development). Although scleractinian coral diversity is lower on these reefs there are higher levels of endemism especially for soft corals (Schleyer, 2000). In this area the Bazaruto Archipelago has relatively high coral community and genera diversity (~26, Rodrigues *et al.*, 2000). The sabellarid dominated reefs of Inhaca Island are unique in the region.

Over 60 coral genera have been recorded in Madagascar and the reef system of the southwest is the most extensive in the Indian Ocean (490 km of reefs, of which about 50 km are true barrier reef). Madagascar is estimated to possess a total of 3000 km of reefs, being a mix of fringing, barrier, patch, island and submerged reefs. It possesses about 265 offshore islands (Cooke 1996). In the other Mascarene islands coral diversity decreases from east to west reflecting the age of the volcanic formations (GBRMP/WB/IUCN, 1995). Rodriguez has the best developed reefs and highest diversity with Mauritius having extensive but less diverse reefs and there is only a small amount of reef development around Reunion and the smaller islands (Nain et al. 2000). The difference in coral growth between islands has been attributed to the relative ages of the islands (Salm, 1976). The Caragados Carajos shoals have over 190 km^2 of coral reef and probably the largest algal ridge in the Indian Ocean GBRMP/WB/ IUCN, 1995; Sheppard, 2000). Mayotte has a barrier reef and there is significant coral growth around Moheli in the Comoros. Seychelles is the only country in the region with coral atolls (Providence, Cosmoledo, Aldabra, Astove, Farquhar and Desroches). The granitic islands have small fringing reefs with other reefs occurring on coralline islands and submerged limestone banks. Detailed descriptions of reefs in each country are available in UNEP/IUCN (1988) and for certain countries in McClanahan et al. (2000).

Mangrove Forests are primarily associated with river estuaries and deltas along the East African coast and the west coast of Madagascar with only isolated stands or poorly developed fringes in other areas. Eleven species of mangrove (GBRMPA/WB/IUCN 1995) are found in a total coverage for the Region estimated at 1.2 million ha although figures vary (Fisher and Spalding 1993; CEC 1992). On the East African coast the ecoregion priority assessment identified one forest as being globally important (Rufiji River Delta) (53,255 Ha) with a further five sites being regionally important (Table 1) (WWF, in litt).

Table 1. Globally or regionally important mangrove forests found on the African Mainland.

Mangrove Forest	Significant features
Rufiji River Delta, Tanzania	Deltaic and rivurine stands. Extensive mangroves in Rufiji (53, 255Ha) with 9 species represented. Very important breeding area for prawns and fish and as nesting site for waterfowl. Abundance of top predators including crocodiles.
Lindi-Ruvuma	Rivurine and deltaic forests with 8 spp. present.
Lamu, Kenya	Extensive 34,500Ha forest with 16,000Ha in pristine condition in delta, creeks and basins. 9 species present. Interaction with wildlife such as Hirora antelope and wild dogs.
Tana Delta Basin, Kenya	River basin mangrove forest. 9 species. Highest concentration of *Heritiera littoralis* in the East African Region
Zambezi River Delta, Mozambique	Largest mangrove formation in Western Indian Ocean (280,000Ha) rivurine, fringing, deltaic, basin and creek formations with large proportion still pristine.
Bazaruto, Mozambique	Forest located in lagoons, bays and creeks within parabolic dunes.

There are 327,000 Ha of mangrove in Madagascar with some of the most extensive stands in the Region occurring at Baie de Bombetoka (46,000Ha) and Baie de la Mahajamba (35,000 Ha. The two largest, possibly undisturbed, stands on the granitic Seychelles are at the end of Bay Laraie on Curieuse and Mahe. Aldabra has a fringe of mangroves on the large lagoon. Very narrow stands occur on Mauritius with the best example being found on the east coast islands e.g. Ile de Cerfs. Moheli has the best representative stands of mangroves in the Comoros and there are about 12km^2 of mangroves on Reunion.

Seagrass Beds are found in all countries in the **r**egion (IUCN/UNEP 1984a), with 12 species of sea grasses. Regionally important, extensive and diverse beds occur along the mainland coast in Kenya (Lamu to Kiunga, Mida Creek, Gazi Bay), Tanzania (west coast of Pemba Island, Tanga, Latham Island, Rufiji River Delta) and Mozambique (some of the most extensive stands occur in Bazaruto (Salm 1994), with others in Xai Xai and from Maputo Bay to Greater St. Lucia in South Africa) and Angoche (Dutton 1994). Other notable seagrass beds are found in Madagascar in lagoons north of Toliara and in bays around Nosy Be and on the Seychelles and Amirantes Banks as well as Desroches Atoll in the Seychelles (GBRMPA/WB/IUCN 1995).

Wetlands. This section examines wetlands other than coral reefs, mangroves and seagrass beds including estuaries, deltas, coastal lakes and swamps. Among the more original wetlands in the Region are the brackish coastal barrier lakes found in southern Mozambique and on the east coast of Madagascar (the Pangalanes Canal but low nutrients limit biological interest). These coastal lakes are found behind sand dunes and are often part of more extensive wetland complexes. Globally or regionally important sites for coastal barrier lakes in Mozambique are Bazaruto-Sao Sebastio (Global) and Maputo Bay-Machangelo (Regional), with Pati and Verdico Lagoon and Chidenguele and Quissico being of likely importance although no information is currently available (WWF, *in litt.*). This report also identified the Zambezi Delta (Global) and Maputo Bay-Machangelo (Regional) in Mozambique and the Tana River Delta, Sabaki River Delta and Lamu-Tenewi complex (all Regional) in Kenya as globally or regionally important wetlands. One site in Kenya (Umba River), six sites in Tanzania (Jozani, Ruvu-Wami-Sadani, Mzinga Creek, Rufiji Delta, Mafia Island and Kilwa) and Ruvuma in Mozambique were identified as areas of likely importance although information was lacking. The west coast of Madagascar has several estuaries of likely importance (IUCN/UNEP 1984a) but little specific information is available, although they are known to contain primitive cichlid fishes (Shumway, 1999). Madagascar's lakes, streams and wetlands reportedly contain 29 endemic fish species, 19 species of mollusc and the Madagascar big headed turtle (Shumway, 1999).

Beaches, Dunes and Cliffs.
Sandy beaches and cliffs are found in all countries but dunes are not found in the Seychelles, Reunion and Comoros. Dunes are best developed in southern Mozambique and are often forested and are associated with coastal barrier lakes in areas such as Bazaruto-Sao Sebastio (Global) and Maputo (Regional), with Pati and Verdico Lagoon and Chidenguele and Quissico (WWF in litt.). Other notable dunes are found in Southern Somalia, Northern Kenya at Tenewi and Lamu (WWF, in litt.), Ruvuma in northern Mozambique and in South Eastern Madagascar where they occur with sand barrier beaches along the east coast (Alusa and Ogallo, 1992).

Islands and Submerged Banks
Islands are found in all countries (IUCN/UNEP, 1984a) and some counties in the region are a number of relatively small islands (Seychelles, Comoros). Islands can be important for island forest communities, rare or endangered biota (Table 2), bird nesting sites (see Birds below)

and/or turtle nesting sites (see Reptiles below). This table is incomplete, as it does not include specific details of the many small islands around the Seychelles and the Mascarenes other than Madagascar. The inclusion of island fauna in the designation of marine and small island sites also raises the question of whether terrestrial systems adjacent to larger island and mainland marine sites should also be included in natural marine and small island World Heritage Sites (see also Candidate Sites below).

Table 2. Significant sites for island biota in East African Region

Island	Location	Significant Feature(s)
Chumbe Island	Zanzibar, Tanzania	Island forest, coconut crabs (*Birgus latro*)
Misali Island	Pemba, Tanzania	Island forest, Pemban vervet monkey ***Ceropithecus aethiops nesiotes***, fruit bats (*Pteropus voetskowii)*, Fischer's Turaco, coconut crabs (*Birgus latro*).
Anjoane	Comoros	Island forest, Livingstone Fruit Bat *(Pteropus livingstonii)*
Grand Comore	Comoros	Volcano and number of endemic species
Moheli	Comoros	
Aldabra Atoll	Seychelles	Giant tortoise (*Geochelone dussumiere*) endemic species
Mafia Island	Tanzania	Remnant coastal forest, hippopotamus, possible sub-species of fruit bat (*Pteropus comorensis)*
Ile d'Europa (France)	W of Madagascar	Largest sea turtle nesting site (mainly *Chelonia mydas*) in the region
Juan de Nova (France)	W of Madagascar	Important for sea turtles and sea birds (especially terns)
Madagascar and islands	Madagascar	Itself an island continent, with most taxa endemic, Madagascar possesses about 265 offshore islands and islets, many of which are important for seabirds, turtles and other flora and fauna

The Region also has a number of large, partly or completely submerged limestone plateaux notably around Mauritius (Hawkins, Soudan, St. Brandon and Nazareth Banks and the Caragados Carajos Shoals); the Seychelles and Amirante Plateaux and Constant, Saya de Malha, Platte and La Perle Banks around the Seychelles. There are also three major seamounts (Paisley in Mozambique) and Tromelin and La Perouse (Reunion). The Banc du Geyser is a large horseshoe reef in international waters that is submerged at high tide and was until relatively recently probably undisturbed because of its isolation (Polunin and Frazier, 1974) but is now heavily fished by Comorian boats (Quod et al 2000). Other notable banks known because of their importance to fisheries are the North Kenya Banks (Watamu and Malindi) and the Pemba Bank (north of Pemba Island, Tanzania). Little information is available on the benthic composition of these areas apart from the Cargados Carajos Shoals that have over 190 km^2 of coral reef and probably the largest algal ridge in the Indian Ocean (GBRMP/WB/IUCN, 1995; Sheppard, 2000).

Fish

Mauritius, Reunion and Rodrigues are known for their high endemism of reef fish (Briggs, 1974) and the southern Mozambique shelf reportedly has the highest global endemism and diversity of sea breams (WWF, in litt.). Grand Comore has the largest known population of Coelacanth, 200-300 individuals (Fatouma et al. 2000), with the "living fossil" also found in southern Mozambique (1 specimen) and near Toliara, south west Madagascar (4 specimens reported to date). Areas of high coral reef fish diversity are Madagascar (McCallister et. al. 1993) with at least 850 species (A. Cooke, pers. comm.), including 715 species reported for the Toliara Grand Récif (Maugé, 1967), with ecological distributions described for 552 species (Harmelin-Vivien, 1977) and the Seychelles (900 species, one third reef based) (GEF, 1992). Other important areas for reef fish are Pemba and Mafia Islands in Tanzania, the Quirimba and Bazaruto Archipelagos in Mozambique with the southern Somalia and northern

Kenya area (e.g. Bajuni Archipelago and Kiunga) thought to be of importance (WWF, in litt.). On the North Kenya, Pemba Banks and Latham Island there are globally important congregations of Black Marlin (*Makaira indica*) that only occur in these densities in East Africa and Australia (van der Elst, *pers com*). This area is also a world renowned sport fishery for Pacific Sailfish (*Istiophorus platypterus*). Latham Island is another globally recognised sport fishing area with a high diversity and abundance of large pelagic fish as well as sharks and rays.

Reptiles

There are five species of turtle in the East African Region the green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*) and the olive ridley (*Lepidochelys oliceae*). The Green and Hawksbill are most common and found in localised sites throughout the region with main nesting beaches on islands (Table 3). Mozambique has significant nesting sites for loggerhead, leatherback and olive ridley turtles.

Table 3. Significant sites for turtles in East African Region

Location	Country	Description
South coast	Mozambique	Loggerhead and leatherback nesting sites on mainland.
Inhambane	Mozambique	Loggerhead and leatherback nesting sites on mainland.
Primeiras-Segundas	Mozambique	Green turtle nesting sites
Bazaruto	Mozambique	Breeding site for 4 species, loggerhead, leatherback, green, hawksbill
Kiunga-Ras Tenewi	Kenya	Nesting sites for olive ridley, green and hawksbill
Bajuni	Somalia	Nesting sites for olive ridley, green and hawksbill
Aldabra	Seychelles	Very high numbers of nesting green turtles
Europa,	Reunion	Highest number of nesting green turtles in Indian Ocean
Tromelin	Reunion	Very high numbers of nesting green turtles
Caragados Carajas	Mauritius	Nesting site for hundreds of green turtles
Moheli	Comoros	Significant numbers of nesting green turtles
Poivre, Coativy	Seychelles	Most significant hawksbill nesting areas
West coast islands	Madagascar	Green and hawksbill, occasional olive ridley
South East Coast	Madagascar	Loggerhead nesting area

Of other reptiles, crocodiles are known to occur in the Rufiji River Delta and in major rivers along Madagascar's west coast. Sea snakes are thought to be rare with probably only one species likely to be found in the region although others may stray into the area from the northern Indian Ocean (Richmond, 1997).

Birds

The region has a diverse variety of seabirds, waders and migrants. Large seabird colonies are usually associated with relatively inaccessible small islands. Significant breeding areas in the Seychelles are Aldabra (12 breeding species), Amirantes (10 species), Cousin, Aride and Bird (10 species) and Providence (5 species). These islands are also important for a number of endemic terrestrial species. Other significant seabird breeding sites are St. Brandon, Round and Tromelin of Reunion); Caragados Carajos in Mauritius and Isles Magnougi and M'Chaco off Moheli in the Comoros (UNEP 1984a; 1984b). Kiunga (8,000 pairs, the world's largest breeding population) in Kenya and Nosy Manitra off the southwest of Madagascar (4,000 pairs) had 30-45% of the world's breeding population of Roseate Tern (*Sterna dougalli*) (GBRMP/WB/IUCN, 1995) bit it has been invaded by fishermen so the colony is certainly threatened. Islands in northern Madagascar harbour globally important populations of Crested tern *Sterna bergii* and Roseate tern ***Sterna dougallii***. Latham Island in Tanzania has colonies of Swift Tern, Black Naped Tern, Sooty Tern, Brown Noddy exceeding 1% of biogeographical population and a Masked Booby colony in excess of 1% of the world's population. The Sabaki River Delta has the highest diversity of seabirds (37 species) using it

as a feeding and resting area including over 1% of the world's population of Sooty Gulls, Saunders Tern, and Lesser Crested Tern.

Significant concentrations of waders, other wetland species and migrant birds are found at Lamu-Tenewi (Ospreys and Pelicans) and Tana River (13 species exceed 1% of world's population) in Kenya; Mzinga Creek and Rufiji Delta in Tanzania; Ruvuma Delta, Zambezi Delta (Wattled Cranes, Pelicans, African Skimmer), Bazaruto-Sao Sebastio (six species exceed 1% world population level) and Maputo Bay-Machangelo (migrants) in Mozambique and northwest coast and islets of Madagascar (Madagascar Fish Eagle, *Haliaeetus vociferoides*)

Marine Invertebrates
Work on the best-known marine invertebrate group in the region, the molluscs, has shown relatively uniform distribution but with high levels of endemism in the southern area of Mozambique and the Mascarenes. Mauritius has at least 4 endemic species of marine mollusc (Naim et al. 2000), Bazaruto in Mozambique 6 species (Dutton and Zolho, 1989) and Inhaca Island has reportedly an unusually high diversity of molluscs with many rare species (Taylor, 1971). The coconut crab ***Birgus latro***, which is globally threatened is abundant and protected on Aldabra in the Seychelles and also exists on several small islands of the mainland coast (Table 2), possibly on Cargados Carajos shoals (UNEP 1984a; 1984b) and on many islets along the north west coast of Madagascar (A. Cooke, pers. comm.).

Marine mammals.
There is only one potentially viable population of dugong left in the region in Bazaruto Mozambique although a small population did exist in Kiunga, Kenya until this year. There are possibly only a few individuals left (Church *pers. com*.), however their status in the adjacent Bajuni Archipelago, Somalia is unknown. Areas to the north and south of Bazaruto, Inhaca Island and Primeiras and Segundas are cited as being important feeding or migratory areas for dugong. Another population now thought to be extinct occurred at Rufiji Delta, Tanzania. Recent reports from Madagascar indicate that dugong are still occasionally taken in several areas but that they have become extremely uncommon (A. Cooke, pers. comm.).

Significant congregations of other marine mammals are found on the mainland at Inhambane (Humpback Whales and Humpback Dolphin), Zambezi Delta (Humpback Whales, Risso's Dolphin and Humpback Dolphin) and Maputo-Michangalo (Southern Right Whale) in Mozambique and at Kiunga in Kenya (Humpback, Sei, Pilot and Sperm Whales). Southern Right Whales are also recorded off the south and east coasts of Madagascar, as is the Sperm Whale, which is also found off Mahe in the Seychelles (Richmond, 1997). From the literature it is not clear whether these are feeding or breeding congregations or are just large groups of migrating animals. The inclusion of feeding and breeding areas could be an important consideration for inclusion in the World Heritage criteria. More work is needed to clarify the significance of these congregations recorded in the East African Region.

Candidate Sites
Compilation of information presented in the above text has identified 42 areas or sites (44 including Aldabra and Greater St. Lucia) that were globally or regionally important for at least one of the eleven indicator groups (Table 4). Seven of these sites have been recognised as being globally important for at least one indicator group, the existing World Heritage Site of Aldabra (Giant Tortoise) and Greater St. Lucia as well as Bazaruto (Dugong and Coastal Lakes), Grande Comore (Coelacanth), Rufiji River Delta (Mangroves), Caragados Carajos (Algal Ridge), Zambezi Delta (Wetlands) and Ile d'Europa (Green Turtles). With the exception of the Ile d'Europa, six of these sites have regional importance for at least one other

indicator group. Four sites including Greater St. Lucia are at least of regional importance for half or over half of the habitat and species groups indicative of high ecosystem/habitat/species diversity. The other three sites are Kiunga (Kenya), Maputo Bay-Inhaca Island (Mozambique) and Toliara (Madagascar). The remaining sites are regionally important for less than half the indicator groups.

Table 4. Sites including country and biogeographic zone (zone) that are globally (XX) or regionally (X) important for selected habitat and species groups. Where: C= Coral reefs and communities, M=Mangrove, SG=Seagrass Beds, W=Wetlands; BDC=Beaches, Dunes and Cliffs; Isl=Small Islands and submerged banks; F=Fish; R=Reptiles; B=Birds; I=Marine Invertebrates and Ma=Marine Mammals. And Ke=Kenya; Tz=Tanzania; Moz=Mozambique; SA=South Africa; Sey=Seychelles; Com=Comoros; Mad=Madagascar; Reu=La Reunion; Mau=Mauritius.

Site No.	Site	Country	No. Gps.	Habitats						Species				
				C	M	SG	W	BDC	Isl	F	R	B	I	Ma
1	Aldabra	Sey	4G	X	X				XX			X		
2	Greater St. Lucia	SA	7	X			X	X		X	X	X		X
3	Bazaruto Archipelago	Moz	9G	X	X	X		X		X	X	X	X	XX
4	Caragados Carajos	Mau	6G	X					XX	X	X	X	X	
5	Rufiji River Delta	Tz	4G		XX	X	X					X		
6	Zambezi River Delta	Moz	4G		X		XX					X		X
7	Grande Comore	Com	2G						X	XX				
8	Ile d'Europa	Reu	1G								XX			
9	Kiunga	Ke	8	X	X	X		X		X	X	X		X
10	Maputo Bay-Inhaca I.	Moz	7	X		X		X			X	X	X	X
11	Toliara-Nosy Ve	Mad	6	X		X	X			X		X		X
12	Lamu	Ke	5		X	X	X		X	X				
13	Pemba Island	Tz	4	X		X			X	X				
14	Mafia-Songo Songo	Tz	4	X			X		X	X				
15	Moheli	Com	4	X	X						X	X		
16	Tana River Delta	Ke	3		X		X					X		
17	Malindi	Ke	3	X					X	X				
18	Latham Island	Tz	3			X				X		X		
19	Baie de Bomboleta	Mad	3		X		X					X		
20	Rodriguez I.	Mau	3	X						X			X	
21	Tromelin	Reu	3						X		X	X		
22	Ruvuma Delta	Moz	3		X			X				X		
23	Mnazi Bay	Tz	2	X			X							
24	Quirimba Islands	Moz	2	X						X				
25	Mida Creek	Ke	2			X	X							
26	Xai Xai	Moz	2			X		X						
27	Pati & Verdico Lagoon	Moz	2				X	X						
28	Chidenguele & Quissico Lagoon	Moz	2				X	X						
29	Nosy Be	Mad	2		X	X								
30	Pangalenes	Mad	2				X	X						
31	Providence	Sey	2	X								X		
32	Desroches	Sey	2	X		X								
33	Curieuse	Sey	2		X									
34	Mahe	Sey	2		X									X
35	Anjouane	Sey	1						X					
36	Cosmoledo	Sey	1	X										
37	Astove	Sey	1	X										
38	Farquhar	Sey	1	X										
39	Poivre	Sey	1									X		
40	Coativy	Sey	1									X		
41	Amirantes	Sey	1									X		
42	Cousin	Sey	1									X		

43	Aride	Sey	1									X		
44	Bird	Sey	1									X		

The characteristics of existing World Heritage Sites can be used as standards for the identification of other sites or areas that could merit World Heritage status. Aldabra is globally important for island biota (the endemic Giant Tortoise) and regionally important for three other groups whereas Greater St. Lucia is at least regionally important for 7 of the eleven indicator groups. Thus, if the presence of a globally important indicator group (as in Aldabra) is used to identify potential World Heritage Sites, then six other sites become candidates (Sites 3-9) (Table 4). Similarly if a broad representation of at least regionally important groups are present in an area (as in Greater St. Lucia) then three other sites (Kiunga, Maputo Bay-Inhaca Island and Toliara could also be considered as potential sites (Table 4).

The combination of geographically adjacent sites can increase the number of indicator groups in the larger area and so could provide increased justification for World Heritage status. Using this approach the combination of Mnazi Bay, Ruvuma Delta and Quirimbas Islands results in the formation of the Mnazi Bay-Ruvuma-Quirimba complex with six indicator groups of regional significance compared to a maximum of four for individual sites (Table 5). The approach also increasing the eligibility of three other sites: Rufiji with Mafia-Songo Songo (Tanzania), Kiunga with Lamu (Kenya) and Grande Comore with Moheli and Anjouane in the Comoros (Tables 4 & 5). The remaining site identified in Table 5, Pemba Island, has been added as it is thought to be a unique example of a diverse and deep-water coral community on a granitic island with spectacular underwater scenery. Its inclusion however, needs to be verified by further studies and comparison with the granitic communities in the Seychelles. All of these areas are large and therefore would have to be cluster sites.

Of the 11 candidate sites or areas identified, seven are on the mainland coast and four in the island states. Seven of the sites were given regional priority by GBRMPA/WB/IUCN (1995) and six of the mainland sites were global or global-regional priority (Pemba) in the Ecoregion process (WWF in litt.). There are two possibilities for transboundary sites within the Region, Somalia-Kenya and Tanzania-Mozambique) (Table 5) with a possibility of a trans-regional cluster involving the Maputo Bay-Inhaca Island-Machangalo cluster and Greater St. Lucia. The literature suggests that all sites could be recommended for World Heritage status under criterion (iv), with at least four sites also being eligible under criterion (iii) and seven under (ii) (Table 5). Two sites, the Comoros cluster and Toliara could also be eligible under criterion (i) through the presence of the Coelacanth. Of the seven sites eligible under criterion (ii), four are located in transitional biogeographic areas (Bazaruto, Comoros cluster, Kiunga-Lamu and the Maputo Bay cluster), two are in the Mascarenes, an area of high endemism (Toliara and Caragados Carajos) and one cluster site that straddles the divergence of the South Equatorial Current at Cabo del Gado (Mnazi Bay-Ruvuma-Quirimbas).

These sites were identified by reviewing existing information on primarily marine ecosystems and species, published in papers or in the “grey” literature. There are a significant number of critical information gaps (e.g. Somalia, Mozambique, submerged banks and shoals) that could identify new sites or revise the importance of the identified candidate sites in this report. Moreover, it could be argued that near shore terrestrial and deep water systems such as coastal forests, other vegetation systems and abyssal systems could be part of clusters with shallow water marine sites and improve eligibility for World Heritage status. In Toliara (Madagascar) the spiny bush vegetation is unique to the region, in which of 95% of plants endemic at the national level, over 60% only occur in this region. There are also substantial numbers of local endemic reptiles and an abyss of 1.5 km at St Augustin (located 1km from slope of the reef) that contributes to local nutrient enrichment. Kiunga is adjacent to the Dodori Game Reserve

that has a significant population of the increasingly threatened Wild Hunting Dog (*Lycaon pictus*). Inclusion of oceanic features could also lead to the addition of a further site at Cabo del Gado where the South Equatorial Current separates into the EACC and Mozambique Current to the Mnazi Bay-Ruvuma-Quirimbas cluster (Tanzania & Mozambique) (Table 5).

Table 5. The two existing sites and eleven single or cluster candidate sites identified from review of existing information, country, biogeographic zone (in parentheses), number of indicator groups of at least regional importance represented at the site and the World Heritage Site criteria applicable to the sites. * Given regional priority by GBRMPA/WB/IUCN (1995); ! Given global priority by WWF (*in litt*)

Site Ref.	Site, Country & (Biogeographic Zone)	No. Gps	Criteria	Comments
1	Aldabra, Seychelles (V)* (Existing site)	4G	ii, iii, iv	Existing World Heritage Site could be expanded to include other atolls notably Cosmoledo and Astove. Discussions underway in Seychelles to review possible new sites.
2	Greater St. Lucia, South Africa (IV) (Existing)	7	ii, iii, iv	See introduction. Could form part of transboundary cluster with Maputo Bay-Inhaca Island-Machangalo.
3	Bazaruto Archipelago, Mozambique (IV)*!	9G	ii, iii, iv	Single site within existing protected area. Last viable East African population of dugong and important nesting site for 5 species of turtle. Located in transition zone between tropical and temperate waters with diversity of habitat types and possible significant levels of regional endemism. This area already identified as potential site by national agencies.
4	Rufiji River Delta- Mafia-Songo Songo, Tanzania (III)*!	7G	Iv	A cluster of three sites, providing representation of tropical ecosystems and communities with high diversity and globally important mangrove. One site could be located to link up with the listed cultural site for Kilwa, a historically & culturally important island.
5	Grande Comore-Moheli-Anjouane, Comoros (V)*	5G	i, ii, iii, iv	A cluster of 3 sites for coelacanth (Grande Comore), reefs (including black corals), mangroves, turtles, birds (Moheli) forest and threatened fruit bats (Anjouane).
6	Caragados Carajos, Mauritius (III)*	4G	ii, iv	Single site. Largest algal ridge in the Indian Ocean with coral growth, likely high fish and marine invertebrate endemism, population of threatened coconut crabs.
7	Zambezi River Delta, Mozambique (IV)!	4G	Iv	Part of the largest complex of mangroves in the western Indian Ocean (2,800 km^2). Globally important wetland with globally threatened wetland birds e.g. Wattled Cranes, Pelicans, African Skimmer. Concentrations of Risso's Dolphin, Humpback Dolphins including breeding Humpback Whales.
8	Ile d'Europa, La Reunion (IV)	1G	Iv	Single site. Most important nesting site in Indian Ocean for threatened Green Turtle (*Chelonia mydas).*
9	Kiunga-Lamu, Kenya (II-III)*!	10	ii, iii, iv	Cluster of 2 sites. Diverse ecosystem and habitat diversity in transition area. Spectacular natural beauty. Important for corals, fish, turtles, birds, marine mammals as well as Wild Hunting Dogs in adjacent terrestrial Game Reserve.
10	Maputo Bay-Inhaca I.-Machangalo, Mozambique (IV)*!	7	ii, iv	Possible cluster of 2 sites, one covering Maputo Bay and Inhaca Island and the other further south towards South African border. This area already identified as potential site by national agencies.
11	Toliara-Nosy Ve Madagascar (III)*	6	i, ii, iii, iv	Largest barrier reef in region, high coral and fish diversity. High endemism in freshwater wetlands and coastal vegetation. Also important for seagrass beds, turtles birds and marine mammals (e.g. Sperm Whale). Proximate oceanic abyss. Spectacular scenery. Cultural importance.
12	Mnazi Bay-Ruvuma-Quirimbas, Tanzania & Mozambique (III)!	6	ii, iii, iv	Possible cluster of 2 sites with one transboundary site for Mnazi Bay and Ruvuma complex and the other for Quirimbas. Extensive complex of reefs with high coral diversity (>55 genera). Extensive & diverse seagrass beds. Important turtle feeding and nursery site and feeding area for Crab Plovers. Ruvuma dunes system unique and important for migratory birds with likelihood of rare or endemic flora. This complex straddles area where south equatorial current splits and so could be of importance as source area.
13	Pemba Island, Tanzania (III)*!	4	iii,iv	Possible single site or cluster of 2-3 sites covering Misali Island and one to two other sites. This area is poorly studied but existing work shows high coral and fish diversity with deepest coral growth on mainland (>64m). Important area for pelagic fish and elasmobranches. Spectacular underwater scenery.

Combination of natural sites with cultural sites to form mixed sites can also enhance the eligibility of a number of candidate sites. These sites include Toliara (Madagascar) (one of the world's last large traditional fisheries entirely based in outrigger dugouts with a strong southern pacific content in the marine language reflecting the people's Austronesian origin), Rufiji River Delta-Mafia-Songo Songo (Tanzania) (combined with listed Kilwa cultural site) and Kiunga-Lamu (with listed cultural site at Lamu).

One possible use of the World Heritage Convention would be the development of a network of sites to reinforce the conservation of representative and unique ecosystems, habitats and species in sites that are also important as source areas and so assist in the maintenance of areas outside of their site boundaries. The candidate sites presented in this report represent

four of the five biogeographic sub-regions (Table 5) if Kiunga is recognised to be in the transition area between sub-regions II and III.

Important considerations for nomination of sites under criteria (ii & iv) could be that a site or cluster of sites support: a high diversity of species (globally or regionally distributed) (criterion iv); the proportion of regional or sub-regional endemic species (criterion ii), and/or its location in terms of larval streams and therefore its importance as a source area within the Region (criterion ii). An example of a site with high species diversity and regional and sub-regional endemism in this report is Toliara-Nosy Ve where a review of the literature shows that of the estimated number of 10,627 regional species (Richmond, 1999; 2001), about 7000 or more are found in Madagascar, with over 50% of the known WIO fauna found in the Toliara– Nosy Ve site (Cooke, pers comm.). It also has 32 regional endemic coral reef fish species, of which 4 are specifically endemic to Madagascar reefs as well as very high levels of terrestrial endemism in linked coastal habitats. Sites that have high diversity but possibly low levels of endemism could be the Rufiji-Mafia Island-Songo Songo and Mnazi Bay-Ruvuma-Quirimbas Archipelago complexes. Sites with lower diversity but higher endemism could be those located on the extremes of the region and/or in transition areas e.g. Kiunga-Lamu, Bazaruto, Maputo Bay-Inhaca Island-Machangalo and Caragados Carajos shoals. A site that could be important as a source area is the Mnazi Bay-Ruvuma-Quirimbas Archipelago cluster that straddles the divergence of the South Equatorial Current. However, more work is needed to ensure that the sites identified are representative of general and unique systems and species found in the Region as well as their role as source areas.

Existing Management, Protection Status, National Capacity and Constraints

Legislation for the establishment of marine protected areas (MPAs) exists in all countries where candidate sites have been identified (Table 6). However, much of this legislation is dated and does not cater for the changes in the role and management of MPAs that has taken place over the last 15 years. These include the designation of larger multiple use areas with smaller strict protection zones and the collaboration of other stakeholders other than the administrative authority in management planning and implementation. The changed role of MPAs has been driven by increased population pressure and degree of threat that has restricted possibilities of gazettement of strictly protected areas. Increased size of some MPAs has also been driven by the recognition of links between the different marine as well as coastal habitats. This is a contributory factor in the identification of large areas on the mainland coast by the WWF eco-region process and this report. Under the current criteria World Heritage status would only be given to smaller sites within those larger areas that have more protective management. The development of cluster nomination is a useful tool to enable this type of approach.

One of the other changes in the role of the MPA that also could constrain nomination is their use as tools for broader scale adaptive resource management strategies often employed as part of Integrated Coastal Management (ICM). For example, in an adaptive management strategy an MPA may also be established to provide a source area for fish stock or coral reef replenishment as well as for its intrinsic characteristics. The MPA may have all the necessary requirements for nomination as a single or as part of a cluster site, but if it does not prove to be an effective source area, pressure could be brought to change its status especially in collaboratively managed systems. If that does happen then its protection status could be lowered and may result in its removal from the list with subsequent embarrassment for the applicant nation.

A major constraint to nomination of World Heritage sites in the East African region is the lack of gazettement for any form of protective management for part of all of ten of the eleven identified sites (Bazaruto excepted) (Table 6). Even with sites that are wholly or partly under protective management, little is known of its effectiveness in protecting the natural resources of the area. This lack of knowledge is in itself the result of a lack of systematic monitoring within established MPAs. Much of the information available to assess the impact of management including protection status is anecdotal rather than quantifiable. Contributory factors to these constraints are: lack of capacity to develop conservation management particularly at the local government or community level, lack of financial resources, conflicts between different sectors with regard to sectoral development policy as well as jurisdiction and the high level of threats that many sites are experiencing through increased population and uncoordinated development.

Sectoral conflict and lack of capacity is being addressed by many nations in the East African community through implementation of the Jakarta Mandate and the regional Nairobi Convention. Implementation of the Jakarta Mandate is assisting with the development of Integrated Coastal Management in the Region and so may assist in reducing sectoral conflict. Current activities underway to strengthen the Nairobi Convention include coordination with other conventions and partners, and legal aspects. This may provide a link whereby the World Heritage Convention for coastal, marine and small islands can play a more significant and integral role in the development of management in the Region.

Gaining World Heritage status for a site brings international recognition, access to a small amount of funding and international assistance for management effectiveness. However, it also requires time, effort and scrutiny in the preparation and evaluation of the proposal and there is always the fear of refusal that could lead to embarrassment for the applicant nation. A possible strategy to accelerate applications for World Heritage status is a more proactive approach that links the World Heritage Convention to other global and regional initiatives active in the Region, provides more detailed guidelines for site identification, assists nations in developing proposals that will have a good chance of approval and encourages support for more work to identify candidate sites for World Heritage Status.

Bibliography

CEC. 1992. M*angroves of Africa and Madagascar.* Brussels: Directorate-General for Development, Commission of the European Communities (CEC), ECSCC-EEC-EAEC.

Alusa, A.L. and Ogallo, L.J. (1992) *Implications of expected climate change in the East African Coastal Region: An overview.* UNEP Regional Seas Reports and Studies 149. Nairobi.

Briggs, J.C. 1974. *Marine biogeography.* New York: McGraw-Hill Book Company.

Cooke, A. J., 1996. *Les ilôts*. Définition et délimitation des zones sensibles et lignes directrices pour la préparation des études d'impact environnemental. Knowledge and Effective Policies for Environmental Management (KEPEM). Report No. 39d, November 1996. 41 pp, maps + island inventory.

Dutton, P. 1994. *Past and present status of the Dugong, Dugong dugon in the Bazaruto Archipelago and other known habitats on the Mozambique coast.* Paper presented at the First International Manatee and Dugong Research Conference. Gainsville, FL.

Dutton, P. and Zolho, R. 1989. *Conservation master plan for the sustainable development of the Bazaruto Archipelago, Republic of Mozambique.* Report for the Ministry of Agriculture, Mozambique. 96 pp.

Engdahl, S. & Motta, H, 2000, (ed) Proceedings from the Regional Workshop on the Nomination of Word Natural Heritage Sites, UNESCO/ MICOA

Fatouma, A.A., Bicarima, A. and Ahamada, S. 2000 *Report on the state of management of protected marine areas in Comoros.* Unpublished Report.

Fisher, P, and Spalding, M.D. 1993. *Protected areas with mangrove habitat.* Unpublished report to World Conservation Monitoring Centre, U.K.

GBRMPA/WB/IUCN. 1995 *A global representative system of marine protected areas. Vol. III. Central Indian Ocean, Arabian Seas, East Africa and East Asian Seas.* Great Barrier Reef Marine Park Authority, World Bank and IUCN. Environmental Department World Bank, 1818 H Street, N.W., Washington D.C. 20433, USA.

GEF. 1992. *Seychelles: Biodiversity Conservation and Marine Pollution Abatement Project.* Washington, D.C: Worldbank.

Harmelin-Vivien, M.L. 1977. *Ecological distribution of fishes on the outer slope of Tulear reef (Madagascar).* Proc. Of 3rd International Coral Reef Symposium, Miami.

IUCN/UNEP. 1984a. *Marine and coastal conservation in the East African region.* UNEP Regional Seas Reports and Studies 39. Gland, Switzerland.

IUCN/UNEP. 1984b. *Marine and coastal conservation in the East African region: National reports.* UNEP Regional Seas Reports and Studies 50. Gland, Switzerland.

IUCN/UNEP. 1985. *Management and conservation of renewable marine resources in the Eastern African region.* UNEP Regional Seas Reports and Studies 66. Gland, Switzerland.

IUCN/UNEP. 2001. Conservation of Coastal and Marine Biodiversity in the Eastern Africa Region: Progress in Implementation of the Jakarta Mandate. IUCN Eastern Africa Regional Office, P.O. Box 68200, Nairobi, Kenya. Email: mail@iucnearo.org

Linden, O. and Sporring N. 1999. *Coral Reef Degradation in the Indian Ocean: Status Reports and Presentations 1999.* CORDIO/SAREC Marine Science Program, Stockholm. 108pp.

Lutjeharms, J. R. E., Wedepohl, P. M. and Meeuwis, J. M., 2000. On the surface drift of the East Madagascar and the Mozambique Currents. *South African Journal of Science*, 96(3): 141-147.

Mauge, L.A. (1967). Contribution preliminaire a l'inventaire ichtyologique de la region de Tulear. *Rec. Trav. Sta. Ma. Endoume.* Marseille. Fasc. Hors. Ser., Suppl. 7:101-132.

McCallister, D.E., Schueler, F.W., Roberts, C.M. and Hawkins, J.P. 1993. Mapping and GIS analysis of the global distribution of coral reef fishes on an equal area grid. In R. Miller, ed., *Mapping the Diversity of Nature.* London: Chapman and Hall.

McClanahan, T.R., Sheppard C.R.C, Obura D.O. 2000. eds., Coral Reefs of the Indian Ocean their Ecology and Conservation. Oxford University Press. 525pp. ISBN 0-19-512596-7.

Nain, O., Cuet, C. and Mangar, V. 2000 *The Mascarene Islands.* In T.R. McClanahan, C.R.C. Sheppard, D. O. Obura, eds., Coral Reefs of the Indian Ocean their ecology and Conservation. Oxford University Press. 525pp. ISBN 0-19-512596-7.

National Strategy and Action Plan for the Conservation of Biological Diversity, December 2000, Minister of Production and Environment. Comoros.

Polunin, N.V.C and J.G. Frazier. 1974. Diving reconnaissance of twenty seven western Indian Ocean coral reefs. *Environmental Conservation* 1(1): 71-2.

Quod, J-P, Naim, O. and Abdourazi, F., 2000. The Comoros Archipelago. In: *Seas at the Millennium : An Environmental Evaluation.* Ed. C. Sheppard. Vol II. pp 243-252. Pergamon Press (Elsevier Science), Oxford.

Richmond, M.D. (ed.) 1997. *A Guide to the Seashores of Eastern Africa and the western Indian Ocean Islands.* Sida/Department for Research Cooperation, SAREC. 448 pp.

Richmond, M.D. 1999. *The Biodiversity and Biogeography of shallow-water flora and fauna of the western Indian Ocean with special reference to the Polychaeta, Mollusca and Echinodermata*.

Richmond, M. D., 2001. The marine biodiversity of the western Indian Ocean and its biogeography. How much do we know? pp 241-262 in: *Marine Science Development in Eastern Africa*. Proceedings of the 20th Anniversary Conference on Marine Science in

Tanzania 28 June – 1 July 2001. Richmond, M. D. and J. Francis, eds. Institute of Marine Sciences / Western Indian Ocean Marine Science Association (WIOMSA), Zanzibar, Tanzania. 569 pp.

Rodrigues, M-J., Motta, H., Whittington, M.W., and Schleyer, M. 2000. *Coral Reefs of Mozambique.* In T.R. McClanahan, C.R.C. Sheppard, D. O. Obura, eds., Coral Reefs of the Indian Ocean their ecology and Conservation. Oxford University Press. 525pp. ISBN 0-19-512596-7.

Salm, R.V. 1976. The structure and successional status of three coral reefs at Mauritius. *Proc. Royal Society of Arts and Sciences of Mauritius* 3(2):227-240.

Samoilys, M. 1988a. *A survey of the coral reef fish communities on the Kenyan coast.* WWF Project 3797 Kenya. Technical Report prepared for the Ministry of Tourism and Wildlife.

Samoilys, M. 1988b. *Abundance and species richness of coral reef fish communities on the Kenyan coast: the effects of protective management and fishing.* Proceedings of the 6th International Coral Reef Symposium, Australia.

Schleyer, M.H. 2000. *South African Coral Communities.* In T.R. McClanahan, C.R.C. Sheppard, D. O. Obura, eds., Coral Reefs of the Indian Ocean their ecology and Conservation. Oxford University Press. 525pp. ISBN 0-19-512596-7.

Sheppard, C.R.C. 1987. Biodiversity, productivity and system integrity. *Marine Pollution Bulletin* 34:680-681

Sheppard, C.R.C. 2000. *Coral reefs of the Western Indian Ocean*: *An overview*. In T.R. McClanahan, C.R.C. Sheppard, D. O. Obura, eds., Coral Reefs of the Indian Ocean their ecology and Conservation. Oxford University Press. 525pp. ISBN 0-19-512596-7.

Shumway, C. A. 1999 *Forgotten waters: Freshwater and marine ecosystems in Africa. Strategies for biodiversity conservation and sustainable development.* Boston University, Boston, USA.

UNEP/IUCN 1988. *Coral Reefs of the World: Vol. 2 Indian Ocean, Red Sea and Gulf.* UNEP Regional Seas Directories and Bibliographies, Gland, Switzerland and Cambridge, U.K.:IUCN; Nairobi: UNEP.

Wilkinson, C.R., Linden, O., Cesar, H., Hodgson, G., Rubens, J. and Strong, A.E. 1999. Ecological and socio-economic impacts of 1998 coral mortality in the Indian Ocean: an ENSO impact and a warning for future change? *Ambio* 28: 188-196.

Table 6. Candidate World Heritage Sites in the East African Region.

Name of Site Country (Biogeographic Zone)	Physical Description of Site	Marine Biodiversity Value	Conservation Management	Management Constraints and Environmental Threats	Environmental Monitoring	Association with NGOs
1. Aldabra, Seychelles (V) Existing World Heritage Site could be expanded to include other atolls notably Cosmoledo and Astove.	Four large coral islands that enclose a shallow lagoon and are surrounded by a coral reef. Area: 35,000ha Terrestrial: 18,800ha Mangrove: 2,000ha Marine: 14,200ha	Refuge for some 152,000 giant tortoises *Geochelone gigantea*, the world's largest population of this reptile as well as a breeding site for Green (*Chelonia mydas*) and Hawksbill (*Eretmochelys imbricata)* turtles. There are large seabird colonies including thousands of nesting terns on the atoll.	Strict Nature Reserve gazetted under National parks and Nature Conservancy Act and existing World Heritage Site. Administered by Marine Parks Authority. Strict protective management for high endemism and diversity. Management plan in place and implemented by Seychelles Island Foundation on behalf of government.	Oil spills, introduced terrestrial species, potential of large scale tourism and overfishing.	Terrestrial monitoring does take place but uses different methods and not under a regular programme. Plans to develop more systematic programme.	??
2. Greater St. Lucia, South Africa (IV) Could form part of transboundary cluster with Maputo Bay-Inhaca Island-Machangalo.	Variety of landforms including coral reefs, long sandy beaches, coastal dunes, lake systems, swamps, and extensive reed and papyrus wetlands. Area: 234,556 Ha	The environmental heterogeneity, extreme conditions and a transitional geographic location has produced exceptional species diversity and on-going speciation. The site is also the largest estuarine system in Africa, the southernmost extension of coral reefs on the continent and a breeding area for large numbers of turtles. Whales, dolphins and whale-sharks migrate off-shore and there are huge numbers of waterfowl including large breeding colonies of pelicans, storks, herons and terns.	Includes several Reserves gazetted under ?? and a Marine Reserve (gazette?) and is also a Ramsar site with management plan. Administered by KwaZulu-Natal Nature Conservation Service. Management plan promotes strict protective management for all groups with some diving allowed on selected reefs.	Oil pollution and increased tourism pressure.	Established monitoring programme administered by KwaZulu-Natal Nature Conservation Service and undertaken by a number of national institutions including the Oceanographic Research Institute.	??

Name of Site Country (Biogeographic Zone)	Physical Description of Site	Marine Biodiversity Value	Conservation Management	Management Constraints and Environmental Threats	Environmental Monitoring	Association with NGOs
3. Bazaruto Archipelago, Mozambique (IV)* Single site within existing protected area. This area already identified as potential site by national agencies (Engdahl & Motta, 2000).	Island archipelago with inshore bay. Area: 5034 km^2	Diverse coral communities, 6 endemic gastropod mollusc species. Extensive & diverse seagrass beds. Parabolic sand dunes. Six species of bird exceed 1% global population level. Possibly last viable population of Dugong. 5 dolphin species, 3 whale species, 4 species of turtle and 4 species of shark. 6 endemic mollusc species.	Marine National Park gazetted under Decree 40040 (1955) with management plan and collaborative management focus on species and biodiversity conservation. Administered by National Directorate of Forestry and Wildlife	Reported over-exploitation of some resources (Rodrigues et al. 2000). Rapidly developing tourism interest.	Coral reefs under Coral Reef Degradation in Indian Ocean Programme (CORDIO) Sporadic monitoring of Dugong population most recently supported by WWF Eastern Africa Marine Ecoregion Programme	National Directorate of Forestry and Wildlife supported by project funded by European Union through WWF.
4. Rufiji River Delta-Mafia-Songo Songo, Tanzania (III)* A cluster of three sites, (Mafia Island Marine Park, Rufiji Delta and another site in Songo Songo (Kilwa) reef complex provides representation of tropical ecosystems and communities with high diversity and globally important mangrove (Rufiji). The Songo Songo/Kilwa site could be located to link up with a listed cultural site for Kilwa, a historically & culturally important island.	From northern side of Rufiji Delta to Songo Songo Archipelago Total Area in which clusters will be located: 9490km^2	Extensive, high diversity of coral reef habitats with high coral cover and diversity (>49 genera). Extensive & diverse seagrass beds. Remnant coastal forest and possible sub-species of fruit bat. Rufiji river mouth with extensive rivurine and deltaic mangroves (53 km^2). Very important breeding area for prawns and fish and as nesting and feeding site for waterfowl. Abundance of top predators including crocodiles. Important feeding area for Dugong and turtle. Hippopotamus present.	Southern part of Mafia Island is a Marine Park gazetted under Marine Parks and Reserves Act (1994) administers by Marine Parks and Reserves. Management plan promotes collaborative management Focus on reefs, diversity and tourism. No conservation management in place for Rufiji Delta or Songo Songo/ although Rufiji Delta is protected by Forestry (Mangrove) Ordinance (1958) and could become a Ramsar Site and Songo Songo has been proposed as a Marine Park.	Over-exploitation of resources, destructive fishing methods, mariculture (Rufiji Delta).	Coral reef monitoring in Mafia undertaken by Institute of Marine Sciences, Zanzibar an institution of the University of Dar es Salaam. No monitoring of Songo Songo or Rufiji Delta although data from some studies can be used as baseline.	Management activities of Mafia Island Marine Park under Marine Parks and Reserves Unit currently supported by WWF Tanzania with joint funding from WWF(UK) and Department for International Development, UK (DFID).

Name of Site Country (Biogeographic Zone)	Physical Description of Site	Marine Biodiversity Value	Conservation Management	Management Constraints and Environmental Threats	Environmental Monitoring	Association with NGOs
5. Grande Comore-Moheli-Anjouane, Comoros (V)* Cluster of 3 sites (one site per island).	Three sites on each of the 3 islands: 1) proposed marine reserve in SW Grand Comore for Coelacanth, Moheli Marine Park (40,000Ha) and Mt. Ntringuni forest (Anjouane)	Proposed Coelacanth MPA in Grand Comore has largest (200-300) known population of Coelacanth. Moheli Marine Park has reefs (including black corals), mangroves, turtles, birds. Anjouane site for forest and threatened fruit bats.	Moheli Marine Park established 2001 under new legislation passed in 2001? Collaboratively managed by Direction Générale de l'Environnement and 12 communities with management plan under development. Primary focus on turtles.	Over-exploitation of resources.	Monitoring of turtle nesting in Moheli Marine Park and of fruit bat (*Pteropus livingstonii*) in Mt. Ntringuni Forest (Anjouane).	??
6. Caragados Carajos, Mauritius (III)* Single site.	Complex of 22 islets, cays and shoals on submarine platform. Area: 190 km^2	Largest algal ridge in the Indian Ocean with coral growth, likely high fish and marine invertebrate endemism, population of threatened coconut crabs, turtle and bird nesting sites.	Nature Reserve (Naim et al., 2000) gazetted under Fisheries Act? administered by Ministry of Fisheries and Cooperatives, Marine Parks and Reserves Services Division. Management plan?	Urban development??	Monitoring programme for reef biota and water quality underway but unclear whether this site is included.	??
7. Zambezi River Delta, Mozambique (IV) Single site	Very large (>10,000 km2) complex of mangrove, floodplain, grassland and palm savanna. Area: 12,464 km^2	Part of the largest complex of mangroves in the western Indian Ocean (2,800 km^2). Globally important wetland with globally threatened wetland birds e.g. Wattled Cranes, Pelicans, African Skimmer. Concentrations of Risso's Dolphin, Humpback Dolphins including breeding Humpback Whales.	None	Under threat from upstream dam development controlled by Zambia and Zimbabwe, mariculture and National Government Development plans.	None	None

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8. Ile d'Europa, La Reunion (IV) Single site.	Seamount in Mozambique Channel.	Most important nesting site in Indian Ocean for threatened Green Turtle (*Chelonia mydas).*	Nature Reserve gazetted by Loi littoral? To be administered by recently created Marine Park Association (MPA). National legislation can also create Natural Reserves and National Parks. Management plan?	MPA has no formal power of management as yet.	MPA undertakes monitoring but unknown if this is undertaken at this site.	??
9. Kiunga-Lamu Archipelago Kenya (II-III) Cluster of 2 sites, Kiunga and Lamu. The Lamu site could be linked to the listed cultural site. Possibility of trans-boundary site with Kiunga and Bajuni Archipelago in Somalia	Includes Kiunga Archipelago, Lamu and Ras Tenewi. Area: 6064 km^2	Extensive mangrove formations in delta, creeks and basins (345 km^2) with 160 km^2 in pristine condition. Extensive & diverse seagrass beds. Important breeding site for Olive Ridley, Hawksbill and Green Turtles and Dugong. Most northerly coral reefs known in the region. Possibility of unique coral and fish communities. Humpback, Sei, Pilot and Sperm whales found offshore. Colony of 8,000 Roseate Terns and breeding site for Ospreys and Pelicans. Wild Hunting Dogs hunt dunes and beaches.	Kiunga is a Marine Reserve gazetted under Wildlife Conservation Act administered by Kenya Wildlife Service. Newly drafted management plan in approval process. It is also a Biosphere Reserve (1981). Collaborative management being established. Lamu currently does not have conservation status.	Conflicting mandates between conservation and other government agencies e.g. Kenya Wildlife Service and Department of Fisheries. Destructive fishing, turtle and dugong capture, collection of turtle and bird's eggs. Pollution.	Certain habitats and species e.g. coral reefs and turtles as well as types of resource use (fisheries) monitored by KWS and communities with assistance from CORDIO.	Kenya Wildlife Service is supported by WWF

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10. Maputo Bay-Inhaca I.-Machangalo, Mozambique (IV)* Possible cluster of 2 sites, one covering Maputo Bay and Inhaca Island and the other further south towards South African border. This area already identified as potential site by national agencies (Engdahl & Motta, 2000).	Coastal area with extensive marshes and flooded grasslands, including Maputo Bay and Inhaca Island Area: 4153 km^2	Important feeding area for turtle, dugong and migratory birds e.g. Whimbrel. Endemic fish and plant species. Important for dugong, whales, white shark, whale shark. Coelacanth present. Turtles (Loggerhead and Leatherback) nesting area. Northern limit of migration for Southern Right Whale. Southernmost coral communities in Region. Unique sabellerid and coral communities. High endemism of soft corals.	Part of Inhaca Island forms the Ilhas da Inhaca e dos Portugese Reserve gazetted under Decree 40040 (1955) with focus on biodiversity, research and tourism. Management plan? Administered by Eduardo Mondlane University. No current conservation management in other areas	Lack of funds and capacity. High pressure from urban and new harbour development, dredging from existing harbour, tourism, (pollution?)	Currently monitored under CORDIO with Eduardo Mondlane University and Oceanographic Research Institute, Durban.	ANII: Friends of Inhaca Island local NGO.
11. Toliara-Nosy Ve Madagascar (III)* Possible single site or 2 –3 site cluster? Best to propose: Toliara coastal zone (Baie de Ranobe, Grand Récif and St.Augustin / Nosy Ve	Located on south-west coast of Madagascar it encompasses terrestrial and marine systems including the Toliara Barrier Reef and the island of Nosy Ve	Largest barrier reef in region, high coral and fish diversity. High endemism in freshwater wetlands and coastal vegetation. Also important for seagrass beds, turtles birds and marine mammals (e.g. Sperm Whale). Proximate oceanic abyss with coelacanth. Spectacular scenery. Cultural and historical importance.	Integrated coastal resource management plans are at advanced state of development (fisheries, mangroves, tourism) Two conservation areas have been created under local customary laws (Baie de Ranobe, Nosy Ve islet). Proposed Biosphere Reserve of 200.000 Ha. Approximately 10% of site to be in strict protection or resource management zones.	1) Inadequate resources, 2) lack of objective information; 3) inadequate representation / organisation of resource users; 4) lack of legal mechanisms fro management development & effectiveness; 5) lack of official policy/ incentives to promote integrated planning. Destructive fishing, resource over-exploitation, sedimentation and coral bleaching	The coral reefs have been subject to monitoring since 1997 which will continue under GEF funding; plan for integrated monitoring of the region at an advanced state and equipment being procured; numerous field surveys under way (e.g. Frontier/IHSM), University of Edinburgh.	Madagascar's national environment program has helped establish numerous community-based organisations to represent user communities and several outside NGOs operate in the zone (e.g. WWF, Frontier, Aide Action)

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12. Mnazi Bay-Ruvuma-Quirimbas, Tanzania & Mozambique (III). Possible cluster of 2-3 sites with one transboundary site for Mnazi Bay and Ruvuma complex, Quirimbas and Cabo del Gado, divergence of South Equatorial Current.	This complex straddles area where south equatorial current splits. Mnazi Bay is shallow with extensive reefs. Ruvuma second largest delta on mainland. Quirimbas chain of coralline islands. Area: 9416 km^2	Extensive complex of reefs with high coral diversity (>55 genera). Extensive & diverse seagrass beds. Important turtle feeding and nursery site and feeding area for Crab Plovers. Ruvuma dunes system unique and important for migratory birds with likelihood of rare or endemic flora. South Equatorial current splits into EACC and Mozambique current at Cabo del Gado, possible importance as source area.	Mnazi Bay recently (2000) gazetted under marine parks and Reserves Act (1994) as marine park (200km^2). No management plan to date. Administered by Marine Parks and Reserves. Ruvuma Delta and Quirimbas included in Integrated Coastal Management initiative in Mozambique.	Funds for Marine Parks and Reserves Unit/IUCN/GEF to develop management of Mnazi Bay not released. Management in Mozambique under MICOA. Resource over-exploitation, destructive fishing, capture of endangered species.	No systematic monitoring for all sites developed to date.	Work in Mnazi Bay supported by Tanzanian NGO, Shirikisho
13. Pemba Island, Tanzania (III) Possible single site or cluster of 2-3 sites covering Misali Island and one to two other sites.	Misali is a small island off the west coast of Pemba Island. The area of Misali the island is 90 ha, half of which is protected under a forestry no-cutting order; the area of the marine conservation zone is 22 km2 of which 8% is a total protection zone (no-take zone). Area: ? km^2	High coral and reef fish diversity. Deepest coral growth on mainland (>64m) Island forest, turtle nesting site. Extensive & diverse seagrass beds.	Misali Island is a conservation area gazetted under the Fisheries Act of 1988 and under the forest conservation act of 1996(?) It has a collaborative management plan being developed by Commission of Natural Resources, Zanzibar.	Political unrest. Isolation. Threats: Destructive fishing, cutting of island forest and mangroves; rat infestation despite attempts to eradicate them.	No systematic monitoring although sporadic monitoring of coral reefs has taken place.	Misali Island Conservation Association (MICA) represents a range of island users and is supporting management of the island. CARE International (NOT an Irish NGO) with funds from the Ford Foundation and the MacArthur foundation has assisted in developing the conservation area mainly through studies, although support to management of the MPA has been limited; Green Ocean has provided ranger training.

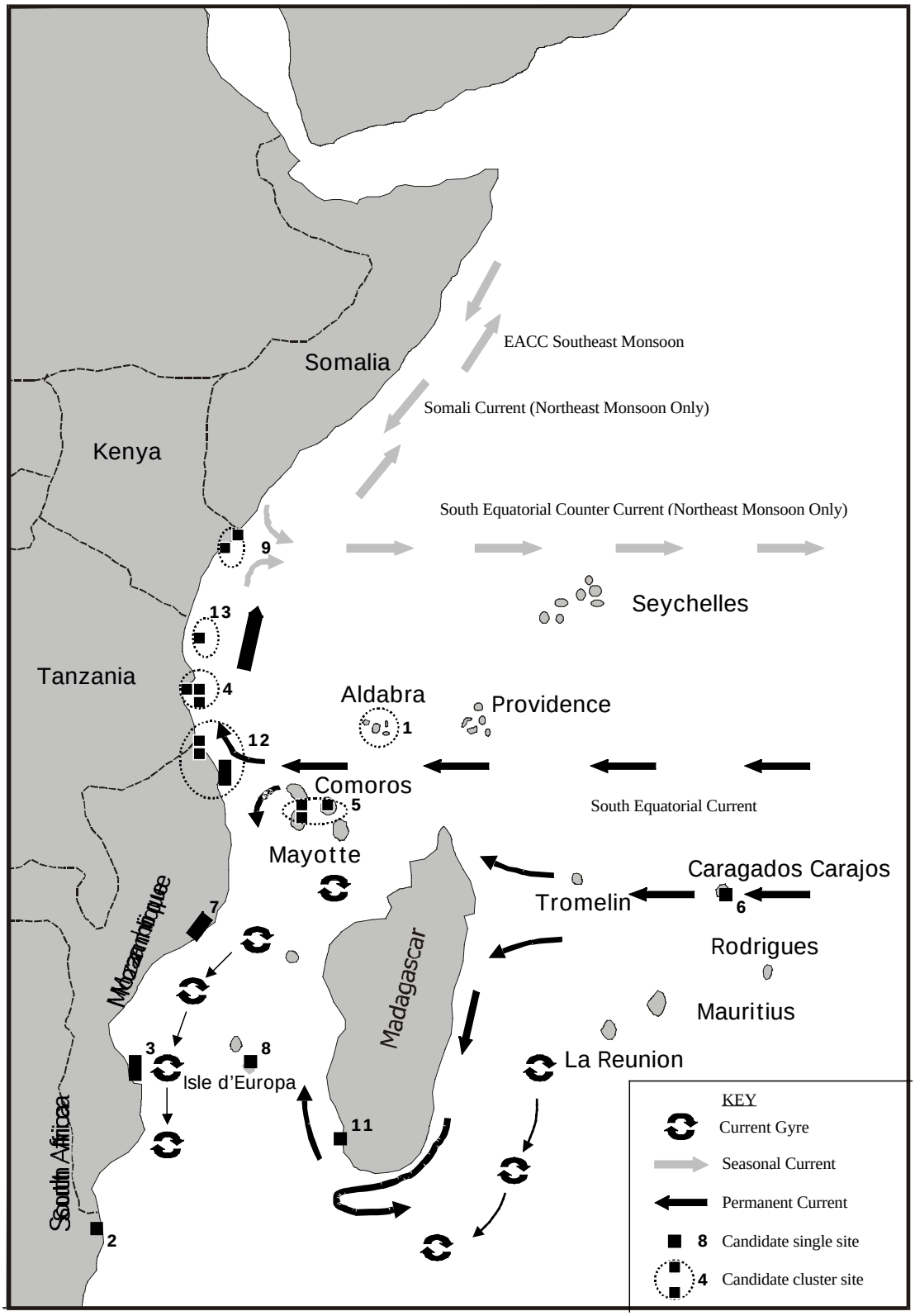

Figure 1. Candidate sites and current patterns in the East African Marine Region